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# Human Factors Engineering for the Loop Plant

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Bell System Loop Plant operations employ 150,000 craftspeople. New technology is changing the demanding johs they perform, and the range of physical characteristics of craftspeople is increasing as women join the traditionally male work force. Both of these factors indicate the need for human factors contributions to designing the tools and apparatus that craftspeople use. This article introduces three other articles describing different aspects of human factors work for the Loop Plant.

## I. INTRODUCTION

The installation, testing, operation, and maintenance of tbe Loop Plant (the customer cable network) requires the full-time employment of some 150,000 outside plant and central office craftspeople—a significant portion of the total Bell System craft work force. An important element of the human factors work in the Loop Transmission Division is knowing the characteristics of the craftspeople and their tasks so that we may supply engineers with human factors criteria for the design of loop apparatus and systems.

The published literature on anthropometrics, biomechanics, human factors, and applied psychology is, of course, a valuable resource.

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However, the literature is often incomplete with respect to Bell System tasks and the data often describe what can be done by people under ideal conditions, not what must be done by craftspeople under stressful conditions. Traditionally, physically demanding tasks have been performed by these craftspeople in suboptimal conditions: up on poles, down in manholes, and during foul weather conditions. While such work is still done, new technologies such as loop electronics, fiber-optic cable, and computer-controlled equipment have overlaid old jobs with more sophisticated tasks, requiring different physical and mental characteristics. Consider loop plant splicers responding to a major alarm concerning a fiber-optic cable repair. The first set of tasks could include lifting a 300-pound manhole cover, pumping "water" out of the manhole, and setting up a work station—perhaps 10 feet down, but still 10 feet from the bottom of the manhole. The next set of tasks could then involve the precision and fine manipulative skills described in the article entitled "Human Factors Comparison of Two Fiber-Optic Continuous-Groove Field-Repair Splicing Techniques" by Larry Paul, in which he compares two metbods of field splicing fiber-optic cable that are currently under development at Bell Laboratories in Atlanta.

In addition to the introduction of new tasks, an increasing number of people of slight stature, particularly females, has altered the anthropometric characteristics of the loop plant work force. Where possible, the physically demanding tasks are redesigned to accommodate this new work force. A case in point is the ubiquitous use of torque knobs in loop plant equipment. In particular they are used to secure splicing equipment, and female craftspeople complain of difficulty in exerting enough torque to hold this heavy equipment in place. The experiment described in the article by George Kohl, entitled "Effects of Shape and Size of Knobs on Maximal Turning Forces Applied by Females," provided design guidelines for matching torque knob shapes and sizes with female capabilities.

The loop plant also includes two main areas for planned manual access to the network: the main distributing frame, and the feeder/distribution interface. At these points a constant "churning" of the loop network takes place in daily installation, removal, and rearrangement of cross-connecting wires. These areas have been very troublesome in the past and any new equipment, hardware, or tasks designed for these crucial access points are closely scrutinized to preclude wiring congestion or poor work practices. Well-motivated, trained craftspeople can always make equipment work but superior designs are required to accommodate the less skilled craftsperson who at one time or another will work on all of the in-place plant. Such attention to design detail and human factors issues is illustrated in the article by Lois

Flamm entitled "Performance in Locating Terminals on a High-Density Connector." This article describes an experiment that identified and helped resolve visual complexities associated with a new and compact protector block designed for use on the main distributing frame.

Many of the more significant loop plant hardware and systems developments are subjected to a full-scale evaluation at the Chester Field Laboratory.[1] Such evaluations take place prior to final production and utilize New Jersey Bell craftspeople to install, operate, and maintain preproduction models in realistic scenarios. However, laboratory experiments play a significant role at a much earlier stage of the design and development process. They may address questions related to the design of specific apparatus or resolve more general questions related to the capabilities of Bell System craftspeople. The articles by Lois Flamm, George Kohl, and Larry Paul are examples of such human factors experiments carried out in Department 54525 as an integral part of the development process of the new Loop Plant.

## REFERENCES


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## AUTHORS


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